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FISHERIES**

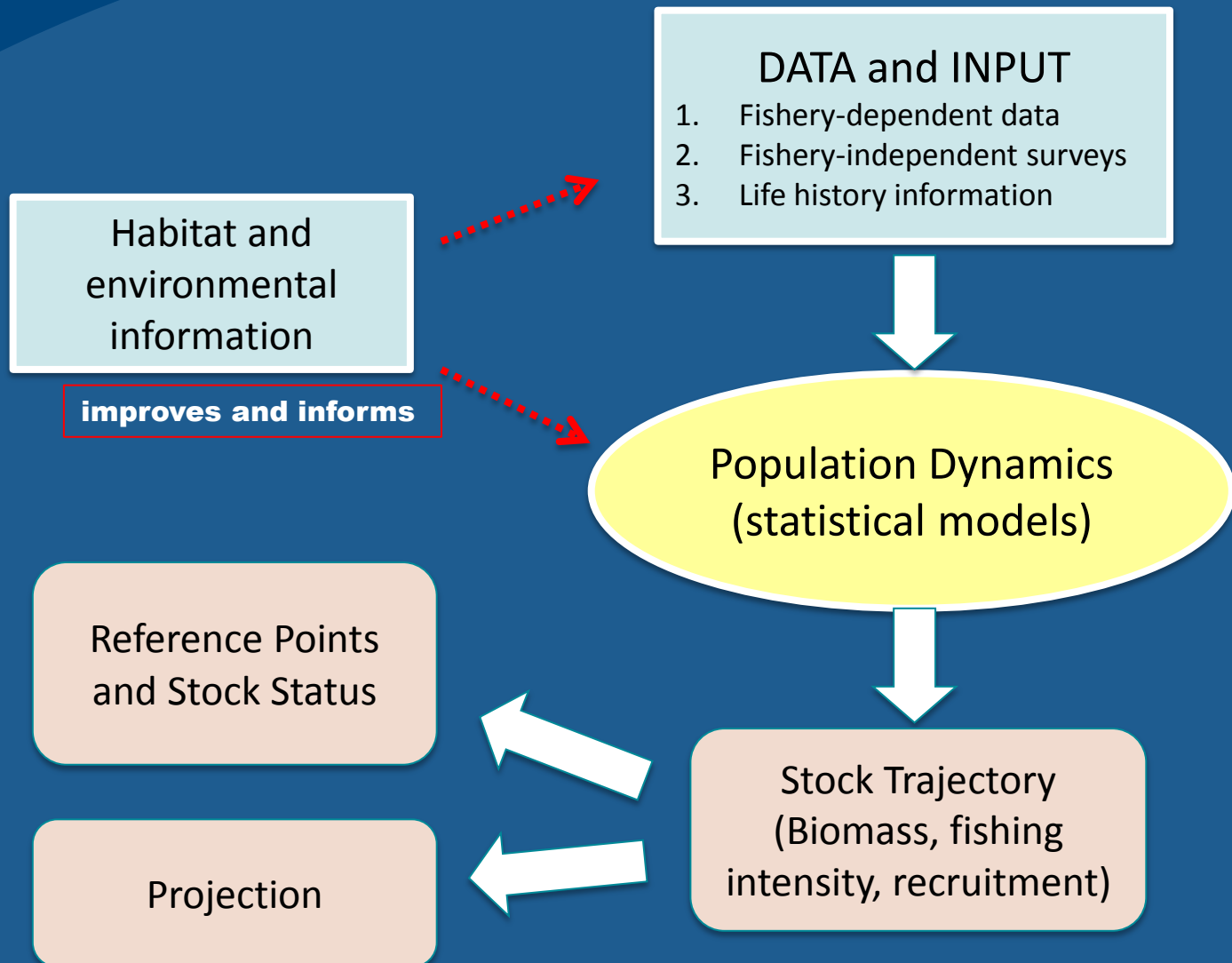
Pacific Islands
Fisheries
Science Center

Data Use in the Assessment of Striped Marlin in the North Pacific

Dr. Hui-Hua Lee

June 25-27, 2013

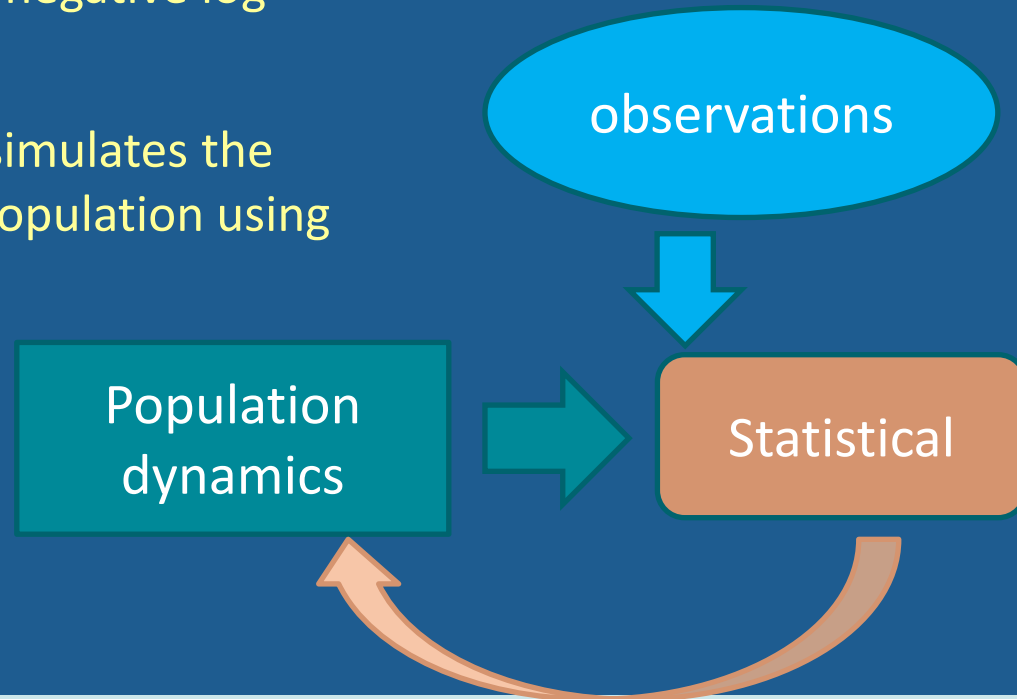
Stock Assessment Process



Overview of integrated assessment model

Stock synthesis Version 3.20b:

- 1) a data sub-component that use of a variety of fishery dependent and independent information (catch, abundance trend, age/size data, biological samples),
- 2) a statistical sub-component that quantifies the fit of model predictions to the data using a negative log-likelihood (NLL) function,
- 3) a population sub-component that simulates the numbers and biomass-at-age of the population using fixed and estimated model processes.



Stock Synthesis Data

- Retained catch
- CPUE and survey abundance

- % Discard
- Mean body weight
- Tag-recapture

- Age composition
 - Within length range
- Size composition
 - By biomass or numbers
 - Within gender
 - Weight bins or length bins
- Mean length-at-age

Stock Synthesis Structure

AREA

Age-specific movement between areas

FLEET / SURVEY

Length-, age-, gender selectivity

NUMBERS-AT-AGE

Cohorts: gender, birth season, growth pattern;
Distributed among areas

CATCH

F to match observed catch;
Catch partitioned into retained and discarded, with discard mortality

RECRUITMENT

Expected recruitment is a function of total female spawning biomass;
Optional environmental input;
Apportioned among cohorts;

PARAMETERS

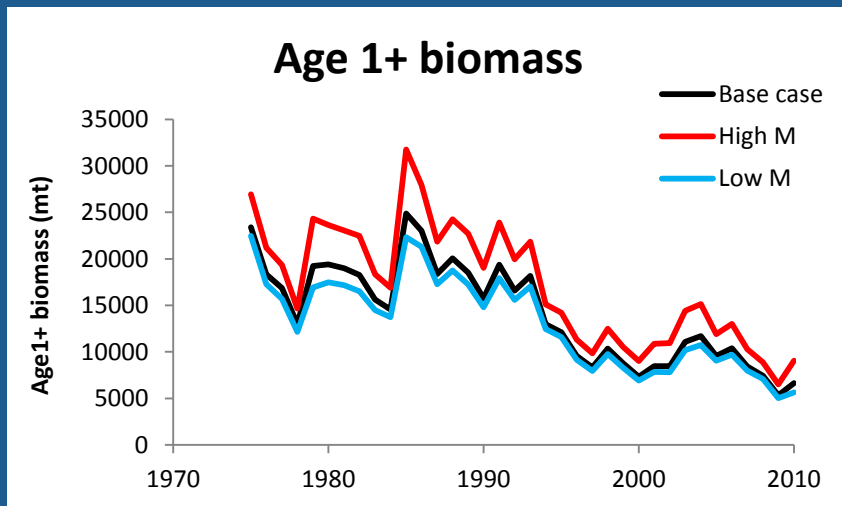
Can have prior/penalty;
Time-vary as time blocks, random annual deviations, or a function of input environmental data

Data and input for striped marlin

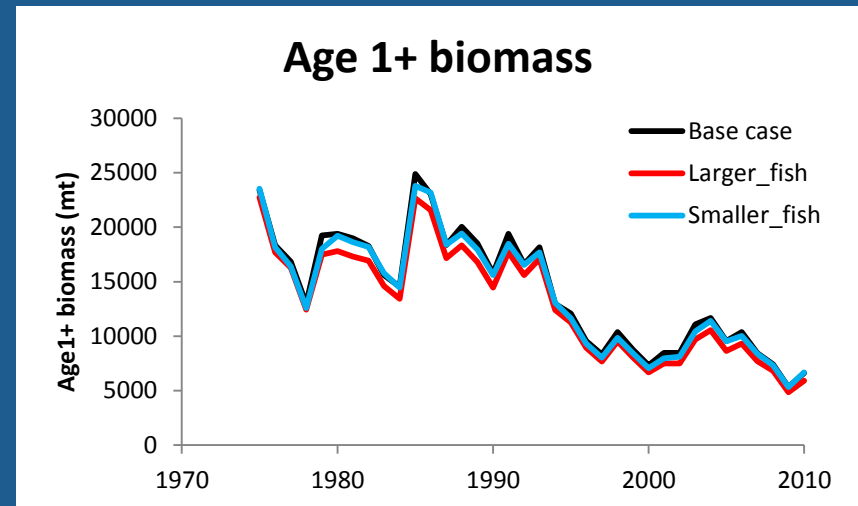
- Life history information
 - Stock structure
 - Growth
 - Maturity and reproduction
 - Natural mortality
- Fishery-dependent data
 - Catch data (commercial and recreational)
 - Abundance index from catch-and-effort data (logbooks or observers)
 - Size information sampled from the catch

Impacts of alternative life history information on assessment

alternative natural mortality

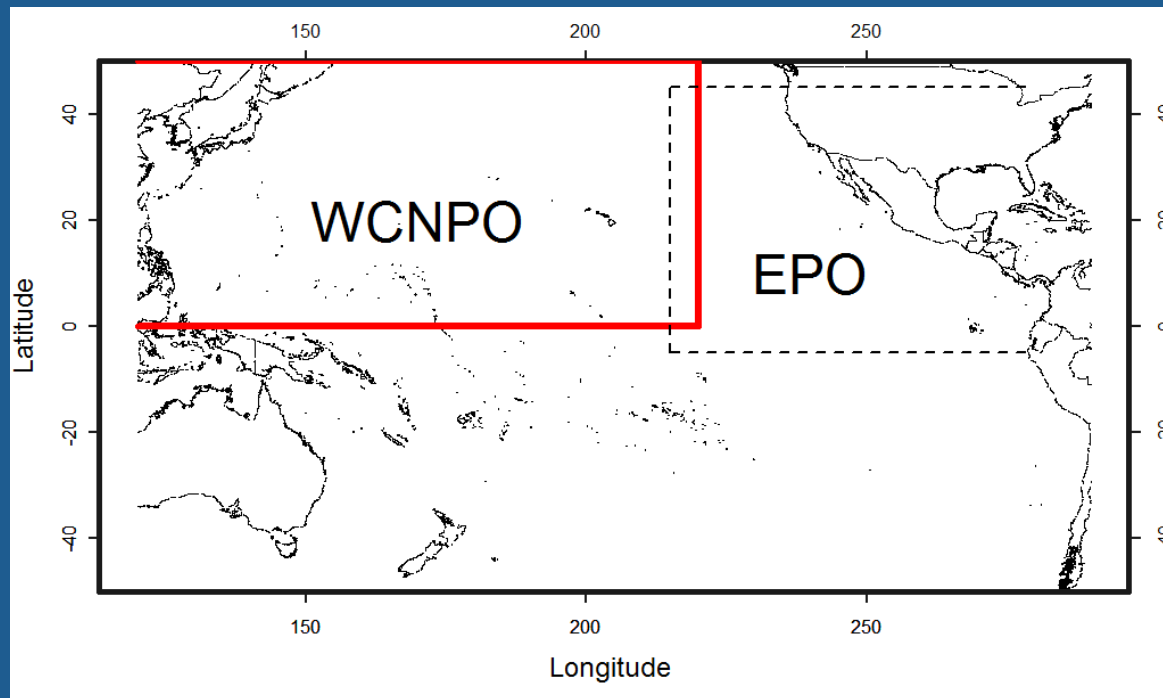


alternative growth curves



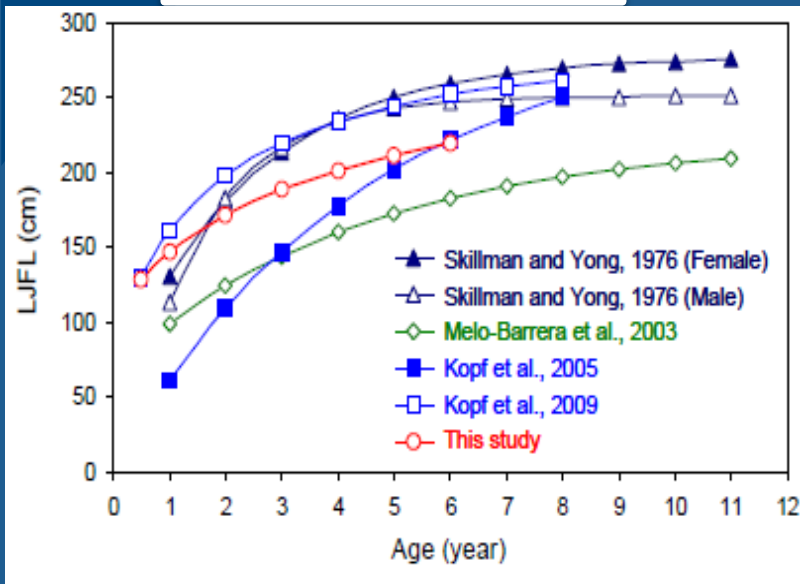
Stock structure

- New genetic studies have been completed since 2007 assessment, indicating that there are at least two distinct genetic populations in the North Pacific.
- The following boundaries are defined by the two Pacific Ocean Regional Fisheries Organizations, ISC and IATTC.



Growth, maturity, and weight-at-length

Growth



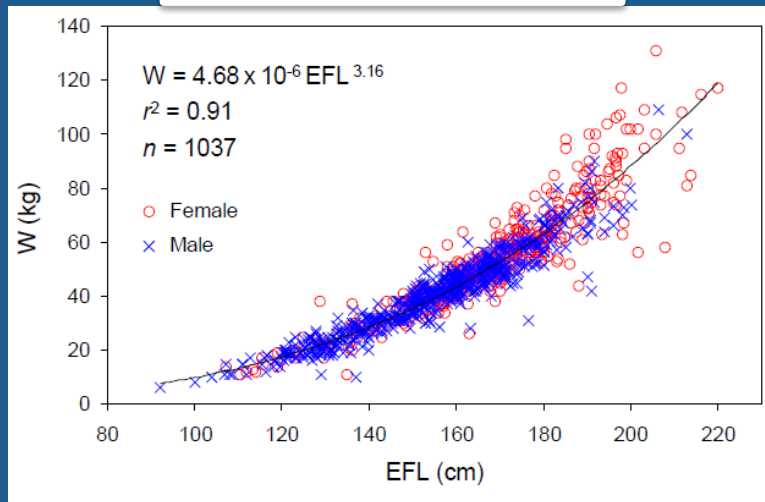
Growth based on otoliths studies from a maximum of age 6 fish (Sun et al. 2011)

- The study by Skillman and Yong (1976) took a quantitative approach by fitting a von Bertalanffy growth equation to the length frequency data collected from the Hawaii longline fleet during 1960-1970.
- The first hardpart based age & growth study was conducted by Melo-Barrera et al. (2003) based on sampling the recreational troll fishery off Mexico.
- No age 0-1 samples and could not corroborate the determination of the first true annulus in their dorsal spine sections using otolith-based age estimates.
- Kopf from southwest Pacific Ocean

Growth, maturity, and weight-at-length

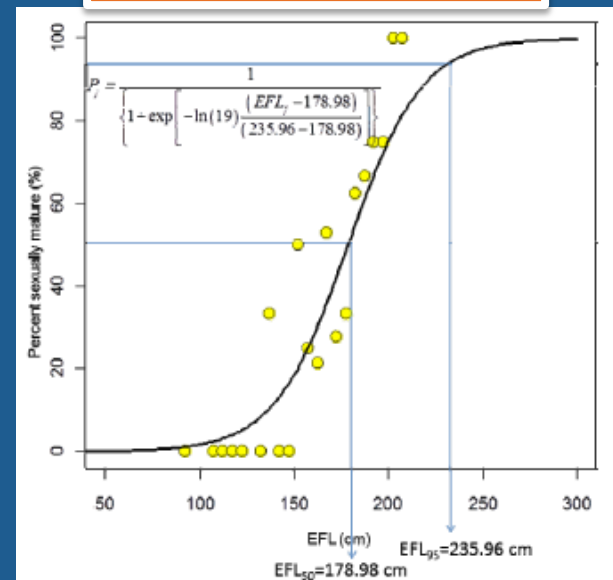
Port sampling from offshore longline, gillnet, and harpoon fisheries off Taiwan waters during 2004-2010.

Weight-at-length



(Sun et al. 2011)

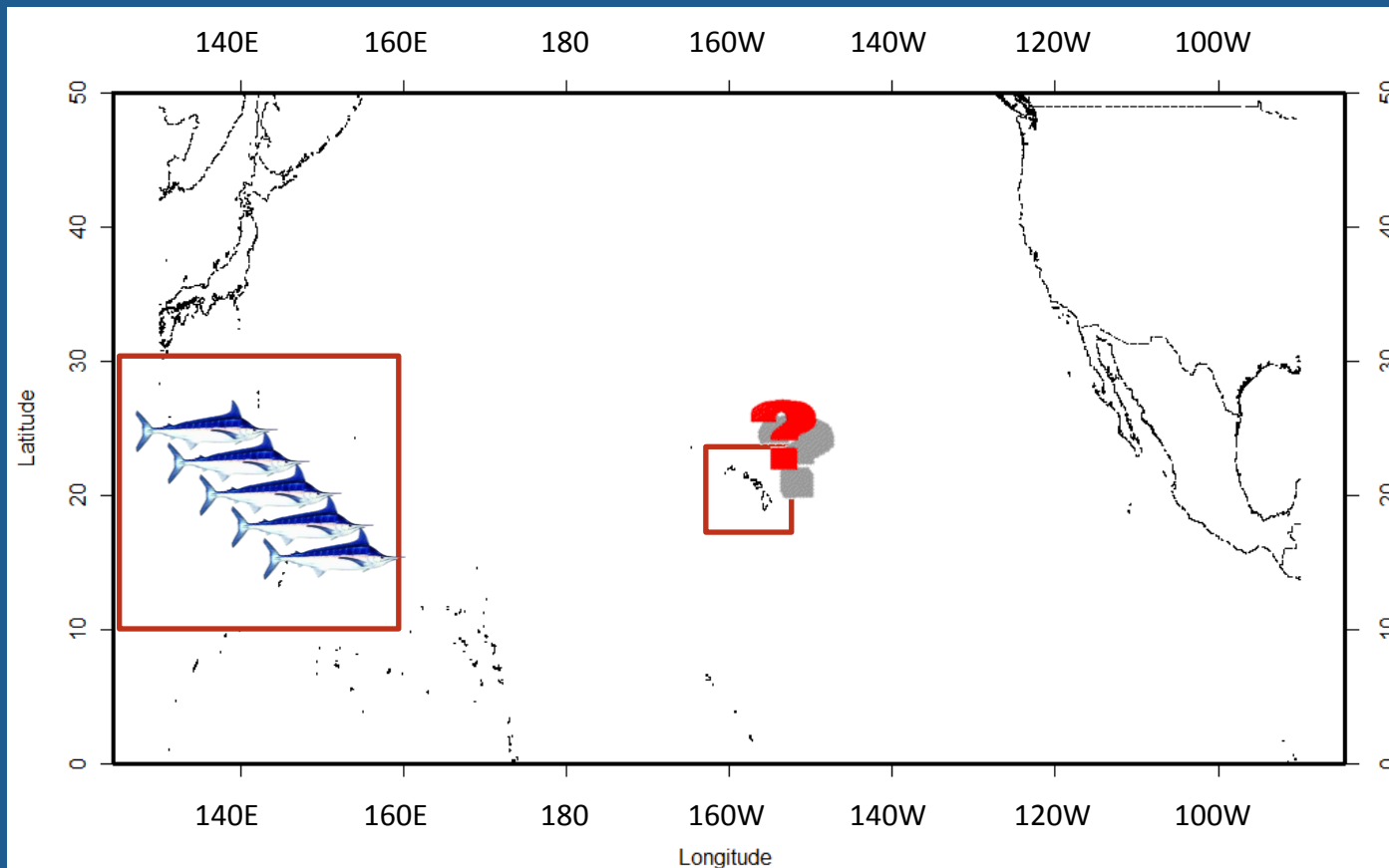
Maturity-at-length



(Sun et al. 2011)

Growth, maturity, and weight-at-length

- Two spawning grounds were identified in the WCNPO.
- We rely on the biological samples from western side of WCNPO.

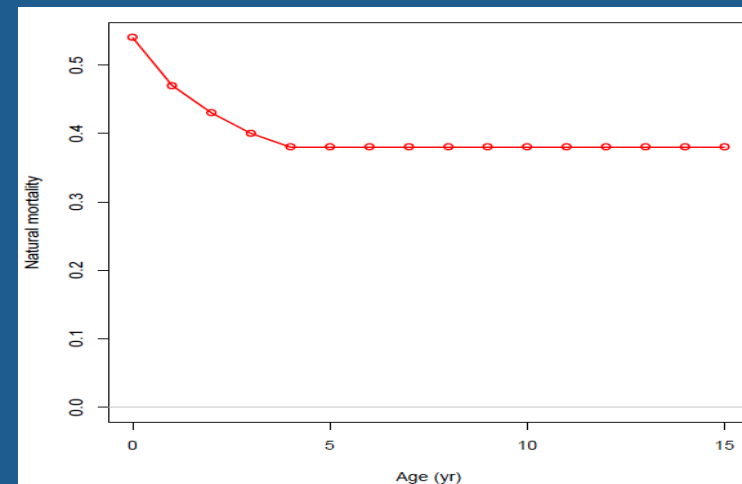


Growth, maturity, and weight-at-length

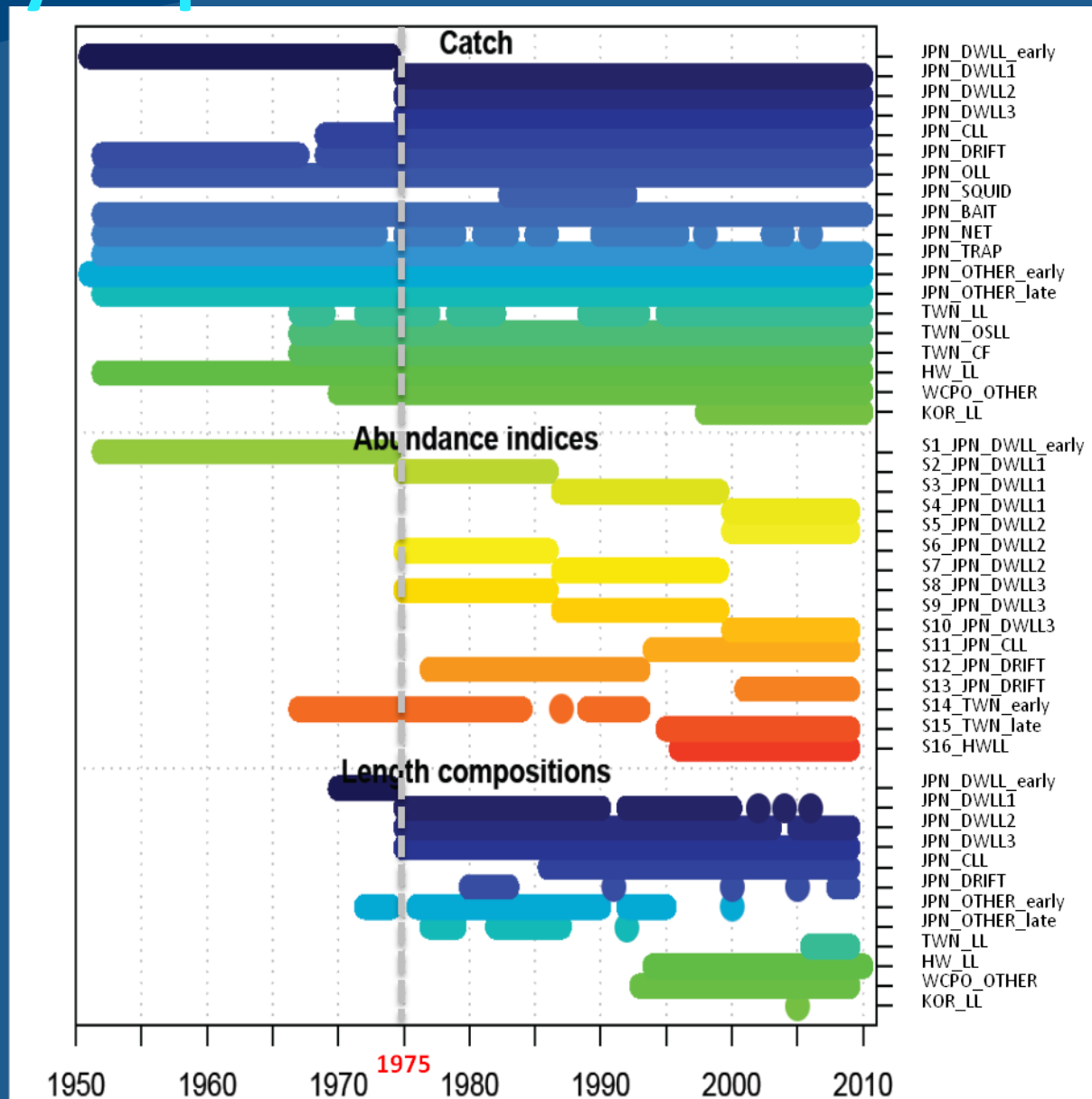
- Growth studies are best conducted when large sample sizes are available that encompass a broad size range of fish collected including age 0 fish and a broad spatial scale.
- Reproductive studies are best conducted when large sample sizes are available that encompass a broad size range of fish collected throughout the spawning season and within spawning grounds by various fishing gears.

Natural mortality

- Estimates are based on indirect methods which are referred to analyses conducted based on estimates of maximum age, life history correlates, and evolutionary-ecology theory.
- Not estimated from direct methods which are referred to analyses using the actual data (e.g. tagging data)
 - Concerns with tagging analysis including representative sampling, non-reporting of tags, tag shedding, and tag induced mortality (either initial or long-term)



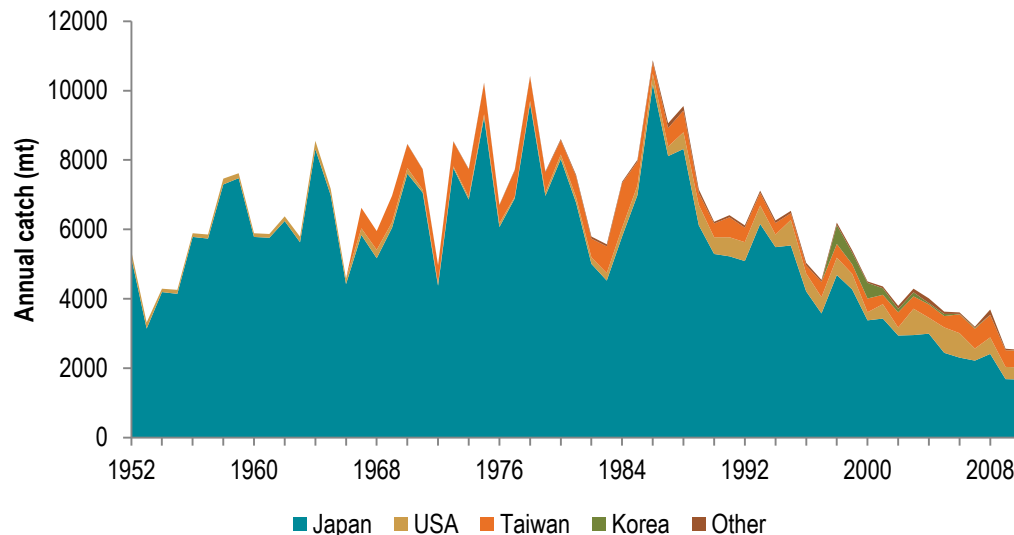
Available fishery-dependent data



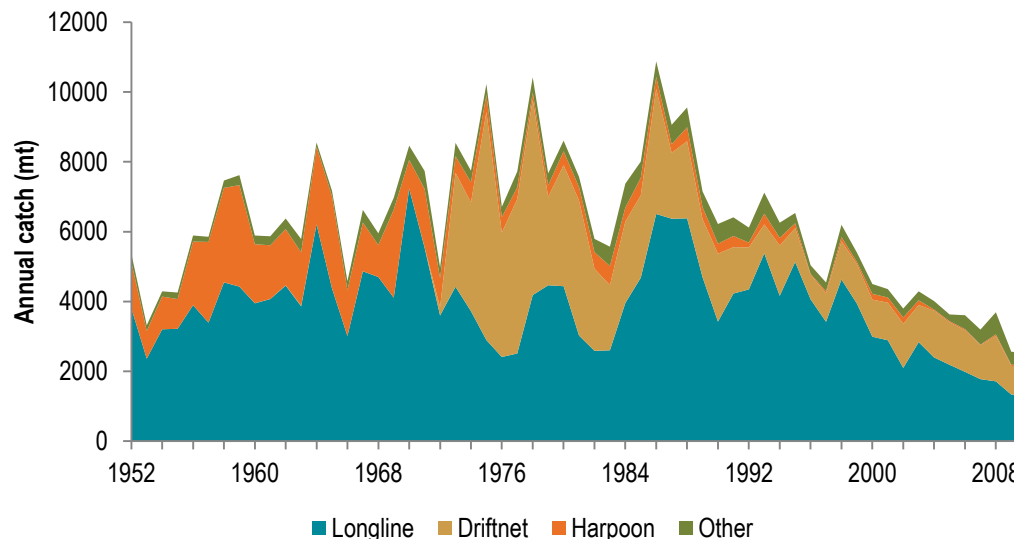
Catch data

- Total removal from the fisheries including discards provided by the ISC members.
- Majority of catch are from Japan. (US account for about 11% since 1990)

(a) Catch by country



(b) Catch by gear



Abundance index from catch-and-effort data

- Catch and effort data were compiled by fishery and used to develop standardized annual indices of relative abundance.
- We rely on the ISC member to provide estimates of abundance indices.

	Japan LL	Taiwan LL	Hawaii LL	Japan coastal driftnet
Data resolution (time-area strata)	Aggregated monthly, 5X5 degree	Aggregated monthly, 5X5 degree	Operational, 1X1 degree	Operational
Source	Raised catch and effort data (Category II)	Raised catch and effort data (Category II)	Observer	logbook
Spatial coverage	WCNPO	WCNPO	Hawaii waters	Japan coastal waters

Abundance index from catch-and-effort data

- Hawaii always provides thorough analyses using the finest resolution data.
- Details will be given in the following talk (stay tune).

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Source	Raised catch and effort data (Category II)	Raised catch and effort data (Category II)	Observer	logbook
Spatial coverage	WCNPO	WCNPO	Hawaii waters	Japan coastal waters

Size information sampled from the catch

- Size frequency data were compiled by year, season, and fishery (spatial).
- We rely on the ISC member to provide size data.

	Japan LL (distant water and coastal) and Japan driftnet	Taiwan LL	Hawaii LL
What is measurement precision?	nearest 1 or 5 cm or nearest 1 kg	nearest 2 cm	nearest 1 cm
How was the measurement taken?	landing ports by samplers or onboard measure by crew	onboard measure by crew	onboard measure by observer
Sampling design	Sample first 30 fish	Sample first 30 fish	Sample from every 3 rd fish

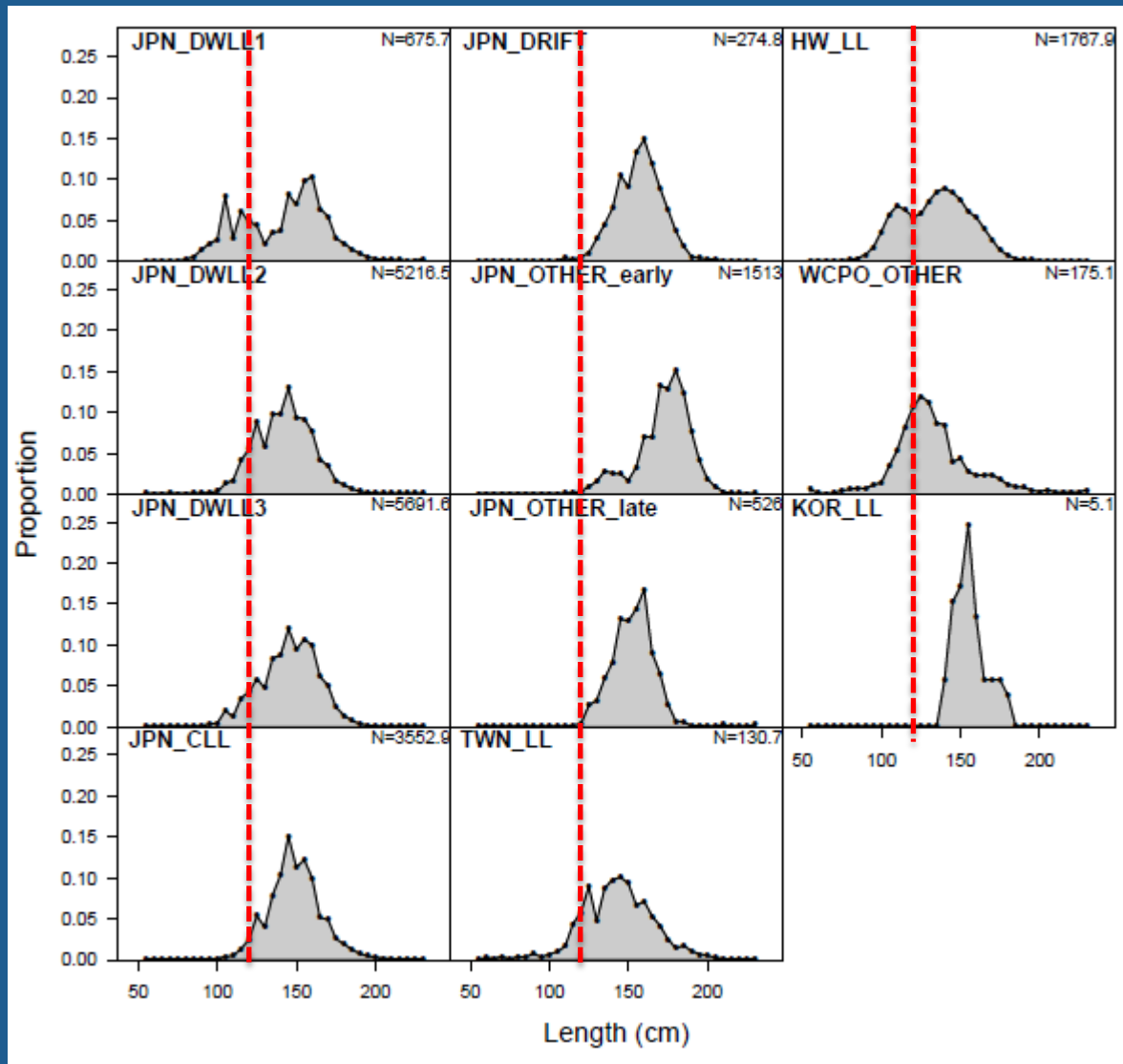
Size information sampled from the catch

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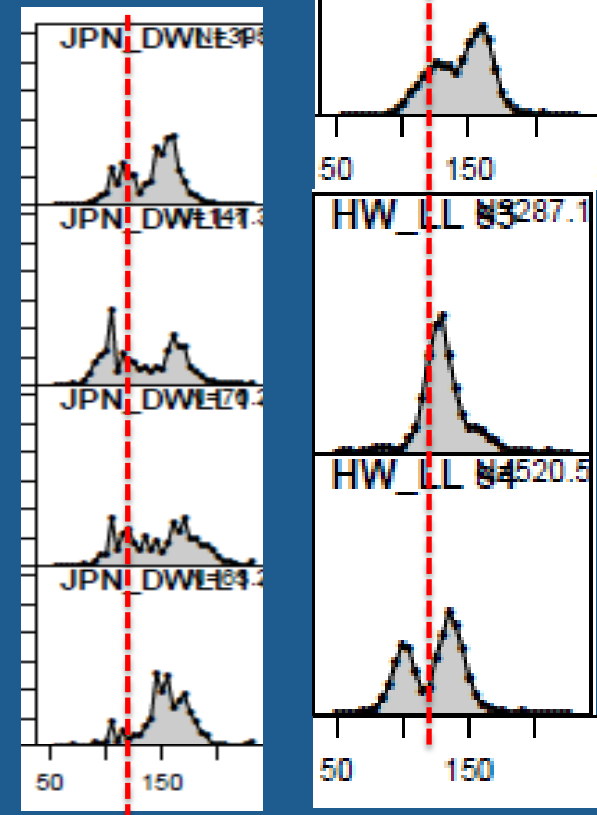
Size distribution by fishery

- Striped marlin grow rapidly during first year.
- Age 0 fish is around 120 cm caught by JPN_DWLL1 and HW_LL.



Size distribution by Hawaii LL

- There is seasonal pattern in Hawaii_LL size.
- Age 0 fish recruit to the HW fishery in season 4 and 1.
- Age 0 fish recruit to the JPN fishery in season 1-3.
- It appears that the timing of peak recruitment varies regionally.



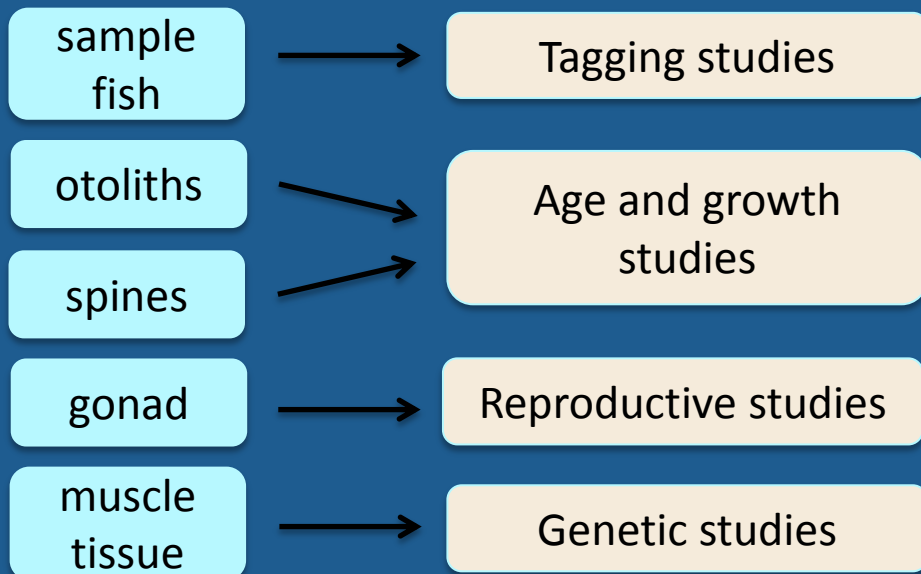
Highly migratory stock assessment

Features: rely on the international collaboration in terms of data and biological information

	Things we could NOT control and improve	Things we could control and improve
Fishery-dependent data	Fishery data from other countries	Bring best available data (corrected catch, discard estimate, spatial and temporal data analysis etc.)
Life history information		Representative biological sampling and collaboration

Data and biosamples are the key

- Representative biological sampling of
 1. sampling design
 2. broad size range of fish
 3. broad temporal and spatial scale
 4. large sample sizes
 5. various fishing gears



by Michael Musyl

Improvement and need of data for highly migratory species

Biosampling

- Ageing:

- Production ageing on regular basis to account for regional and temporal variation of growth.
- Ageing error could be included in the assessment.

- Reproductive studies:

- Sample fish throughout year in spawning grounds.
- Consider regional variation of reproduction.

- International tagging research:

- Understand migration and other key parameters

Oceanography data